VOLCANIC RESURFACING ON VENUS - IMPLICATIONS ON HYPSOMETRIC AND AGE DISTRIBUTION OF THE SURFACE. P. J. Muinonen, Institute of Geosciences and Astronomy, University of Oulu, P.O.Box 333, 90571 Oulu, Finland. E-mail petri.muinonen@oulu.fi

An earlier analytic work on crater embayment on Venus [1,2] is complemented by a simulation study. Both assume a flow emplacement that depends on the topography produced by precedent volcanism. This control takes over as soon as the starting point of a resurfacing flow is decided. The necessary condition of spatially random locations of resurfacing events and cratering apply, of course, as for any model of equilibrium resurfacing. While a commonly used 2D approach with circular flows [e.g. 3,4] does not recognize the adaptation of lavas to pre-existing terrain, the present 3D simulation model is more realistic. First, it seeks to verify the result that a topography-controlled emplacement has a tendency to produce a significantly lower proportion of embayed craters than do simple lava disk models, both analytic and numeric ones. Second, I look for some general characteristics of the landscape developed in the course of the simulation. These include the relative surface age in six elevation ranges, the percentage of surface they occupy, and the average length of the boundary of a single resurfacing flow, both immediately after its emplacement and on a mature surface. The age relations between volcanic resurfacing units and its neighbors are studied as well. They serve as a feed-back for the analytic model, where the proportion of embayed craters depends on the average fraction of margin that a unit has with neighbors older than itself.

The simulation starts from a flat surface where the volume of the resurfacing event is selected so that it occupies an area of approximately 150,000 km^2, which is also considered the maximum extent that still preserves the randomness of the crater distribution [3]. After this primary calibration each flow is expanded until the selected volume is reached. The ratio between flow volume and area (on a reliefless surface) is adjusted by a slope parameter, which in turn depends on the viscosity of the volcanic material. In these tentative runs, one pixel of a simulation grid in vertical direction corresponds to 80 pixels in horizontal direction, or a slope 0.7 degrees. Thus the distance to a pixel above the volcanic source is equal to the one to a point at same level with the source but 80 pixels away. The flow advances to the nearest unoccupied pixel in the grid. Its distance from the source is calculated either directly from the source, or summing up in a stepwise manner from a transition point to another if vertical movements of the flow take place. This is not real flow dynamics since the momentum of lava is largely neglected. However, this is a tolerable approximation for a slowly erupting lava of a low viscosity, for which the local topography most strongly restricts the progress of the flow.

At first the resurfacing units are circular as in simpler models. More complex features are created later on as flows break from high source areas to gaps between these first generation disk-like flows. A kind of an equilibrium is reached in the system when every pixel at the starting level is resurfaced at least once. At that time an average point within the area has already been covered from 3 to 4 times by a resurfacing flow. The systematical growth of the average surface age ceases and is replaced by random fluctuations.

Due to its vast consumption of CPU time, the 3D simulation of volcanic resurfacing is run for a small fraction of surface at a time. Thus the elevations it gives are not defined by the highest and lowest point of the surface for a quick comparison with Venus. However, the spacing of elevation ranges is constant, and comparable to the thickness of the flow. The simulated area corresponds to about 2% of Venus surface, so any definite conclusions can hardly be drawn on age vs.. elevation. Table 1 shows some preliminary results from separate simulations at different stages. What appears most evident to me is the relative aging of highest elevation bins after many cycles of resurfacing. Longer runs across larger areas will reveal if this is a persisting feature. At first look at these individual cases, the hypsometric distribution of the simulated terrain could develop to closely correspond the observations in equilibrium resurfacing.

The statistics of the crater density and deformation will be produced later across larger simulated areas so as to gain a good statistical significance.

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Table 1. Preliminary results of some 3D simulations of volcanic resurfacing on Venus
Every simulation had totally resurfaced the starting level by t=300.

Simulation time **t=500** Average age 60

Elevation bin	% of surface	Age
Highest	0.2	8.2
	2.5	29.8
	31.3	35.4
	41.1	38.6
	22.6	94.2
Lowest	2.2	161.8

Simulation time **t=600** Average age 63

Elevation bin	% of surface	Age
Highest	0.2	14.1
	9.1	34.5
	38.7	59.1
	44.5	67.8
	7.3	111.3
Lowest	0.1	142.8

Simulation time **t=750** Average age 56

Elevation bin	% of surface	Age
Highest	0.4	46.5
	2.1	31.2
	22.2	35.7
	41.7	49.5
	29.7	77.4
Lowest	3.9	134.7

Simulation time **t=1000** Average age 60

Elevation bin	% of surface	Age
Highest	0.5	36.6
	4.0	45.9
	30.1	46.5
	53.9	63.6
	11.3	114.9
Lowest	0.2	212.7

References:

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[4] Strom, R.G.,et al., *JGR*, *99* (E5), 10,899-10,926, 1994